

# Conversion of the egg nest to a brood nest by the female *Brettus cingulatus* (Araneae: Salticidae: Spartaeini)<sup>1</sup>

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**Abstract.** Nesting female *Brettus cingulatus* deposit a layer of silk fibers and white flecks over their eggs. After their young hatch (as first instars), they remain in this nest and emerge at a later date as fully developed second instars. Soon after hatching, almost all of the covering silk fibers and white flecks, and eggshell fragments, disappear from the nest. At the same time the young accumulate dark pigment in the prosoma and opisthosoma, suggesting that the silk provides a protein-rich diet for the young. However, we have now found that the female removes the flecked silk cover of the egg nest (the incubator), and replaces this with a simpler, thin silk covering to produce a brood nest (the nursery) after the young hatch to instar I. Related spartaeines of the genus *Neobrettus* construct similar nests and appear to convert these in the same manner.

**Keywords.** jumping spider, Karnataka, maternal care, mating systems, *Neobrettus*, predation, tropical Asia

The nests of spartaeine jumping spiders of the genera *Brettus* Thorell 1895 and *Neobrettus* Wanless 1984 are comprised of a thin layer of silk fibers and white flecks that appear to be silk, covering a flat cluster of eggs deposited on the surface of a leaf. After the young of these spiders hatch (as first instars), almost all of the silk lines, white flecks, and egg shell fragments rapidly disappear from the nest. (Figures 1-3; Ahmed et al. 2018; Abhijith & Hill 2019; Banerjee, Caleb & Hill 2019; Harshith & Hill 2020).



**Figure 1.** Brooding female *Brettus cingulatus* Thorell 1895. **1**, Guarding recently deposited cluster of eggs covered with silk fibers and white flecks. **2**, Ten days later, guarding hatchlings (first instar). Larger white flecks represent eggshell fragments. **3**, Three days later. All silk, white flecks, and eggshell fragments are gone, and except for their legs, the first instar young are now pigmented. Photographs by Abhijith A. P. C. at his Indraprastha Organic Farm, Kalalwadi Village, Karnataka, India.





**Figure 2.** Brooding female *Brettus cingulatus*. **1-3**, Three females guarding their egg sacs, covered with a silk fabric containing numerous white flecks. **4-6**, Three females guarding their brooding hatchlings (instar I) under a loose layer of silk after the flecked silk cover and eggshell fragments have been removed. **6**, This female, with a relatively large brood, is highly iridescent. Attribution and ©: 1-2, 5, harshithjv; 3-4, Naveen Iyer; 6, ashokdm.





**Figure 3.** Three brooding *Brettus cingulatus* females. **1**, Female guarding recently deposited eggs. **2**, Female with first instar young, still with little pigmentation of the opisthosoma. Note that almost all covering silk, white flecks, and eggshell fragments were absent at this stage. **3**, Later first instar young with full pigmentation of the prosoma and opisthosoma, as well as pigmentation of each femur I. The female (not shown) was still guarding the brood at this stage. Photographs by Arundathi Sambayya taken at Bhimanakone, Sangara Taluk, Shimoga District, Karnataka, India.

The rapid removal of covering silk, white flecks, and eggshell fragments after hatching, as well as the rapid development of dark pigment (prosoma, opisthosoma, femur I) by the first instar young soon after hatching, suggested to us that these materials may have been eaten by the young. However, recent observations indicate that the female *Brettus cingulatus* removes the silk covering of the egg nest and the egg shells soon after her eggs hatch, and then lays down a thin and loose layer of silk over her first instar brood, continuing to watch over them as they develop (Figures 4-8).

Mastication and feeding by the brooding female on materials that are removed suggests that the female obtains some nutrition in the process. After mastication the female removes remaining egg shell fragments from the nest by quickly flicking them away from the periphery, with her pedipalps (Figures 6-7). We have seen no indication that the young feed on any of these materials. Araneid spiders are known to feed on their own silk, a material that is rich in proteins and their constituent amino acids (Peakall 1971; Blackledge, Kuntner & Agnarsson 2011). Analysis of the silk deposited by the female *Brettus cingulatus*, and in particular the distinctive white flecks that these spiders incorporate into their nests, might reveal a special composition to include amino acids and other nutrients. The white flecks may also contribute to concealment of the eggs prior to hatching.

We consider this process to represent *conversion of the egg nest to a brood nest*, a form of maternal care that has not been described for other salticids. The female salticid *Myrmarachne magna* Saitō 1933 was recently found to feed her young in the nest with secretions from the epigastric groove of the female (Chen et al. 2018; Dong, Quan & Chen 2019). For this ant mimic, this behaviour may represent a special adaptation to support the young until they reach a size where they can successfully join the adults in their mimicry of local ants. However we have little evidence that other salticids provide anything other than protection to their broods. For example, *Lyssomanes viridis* females cover their eggs with fine stands of silk but no white flecks, and there is no sign that either this silk or the eggshells of emergent young are removed from the nest as the young mature and molt into emergent second instars (Figure 9).





**Figure 4.** Sequential photographs of a female *Brettus cingulatus* guarding her egg nest (1-3), and later removing the flecked silk covering of that nest with her chelicerae after her eggs have hatched, feeding on that covering (4-8). Photographs by Mohith Shenoy taken at Brahmagiri, Udupi, Karnataka.





**Figure 5 (continued on next page).** Sequence of photographs of a brooding female *Brettus cingulatus*. Photographs by Abhijith A. P. C. on a *Clusia rosea* (autograph tree) at his Indraprastha Organic Farm, Kalalwadi Village, Karnataka, India. **1-11**, Female guarding the egg nest, and contact by an attentive male (9-11). **6**, A minimum of 43 eggs were deposited in this nest.





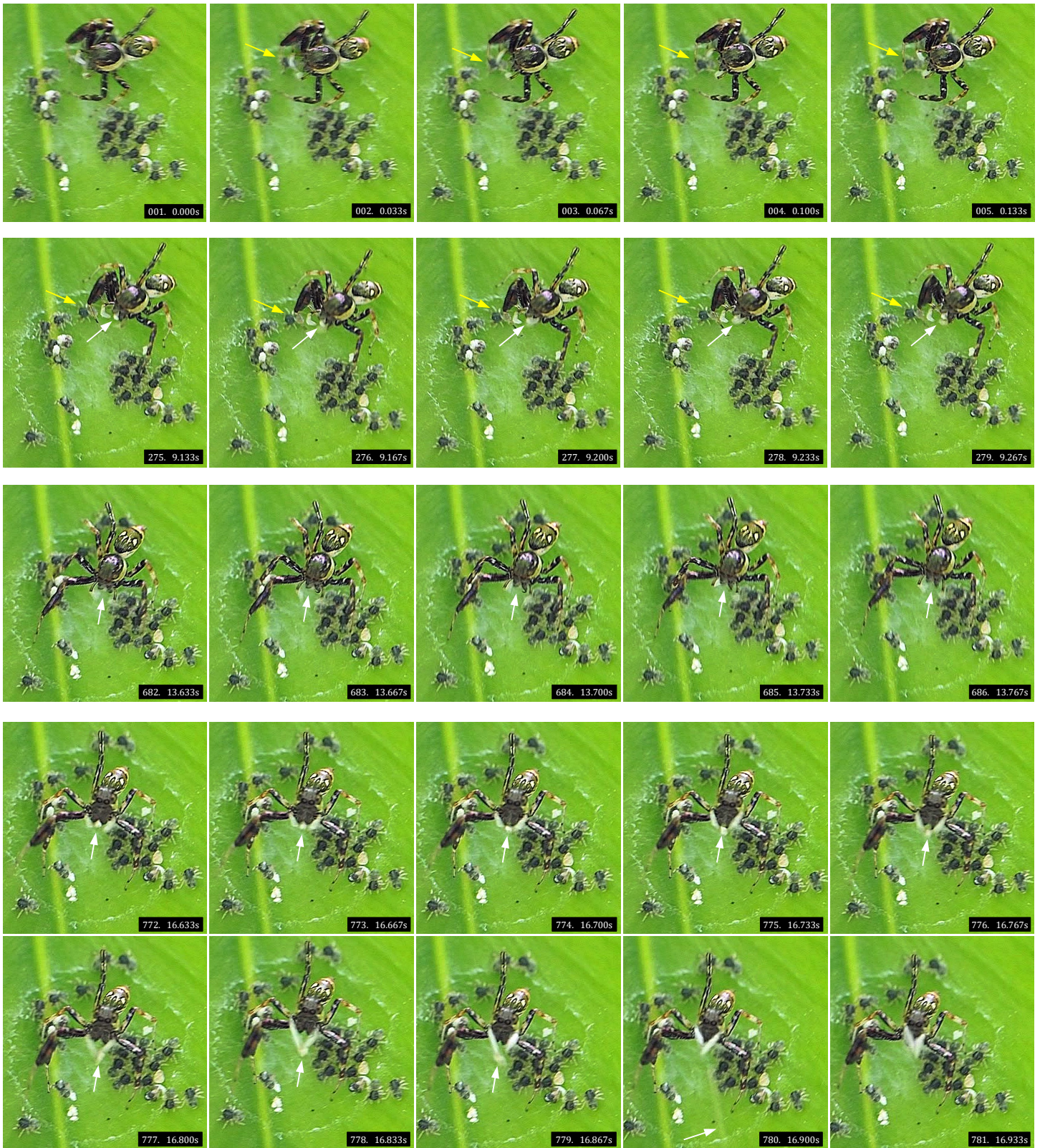
**Figure 5 (continued from previous page, continued on next page).** Sequence of photographs of a brooding female *Brettus cingulatus*. 12-19, Mating on the nest. After mating on the left side (14-16) this male mated on the right side (18-19). 21-22, Female guarding her brood as they hatched. At this stage the opisthosoma of each instar I spiderling is still pale in colour. Note that both this male and this female had lost two legs on the left side.





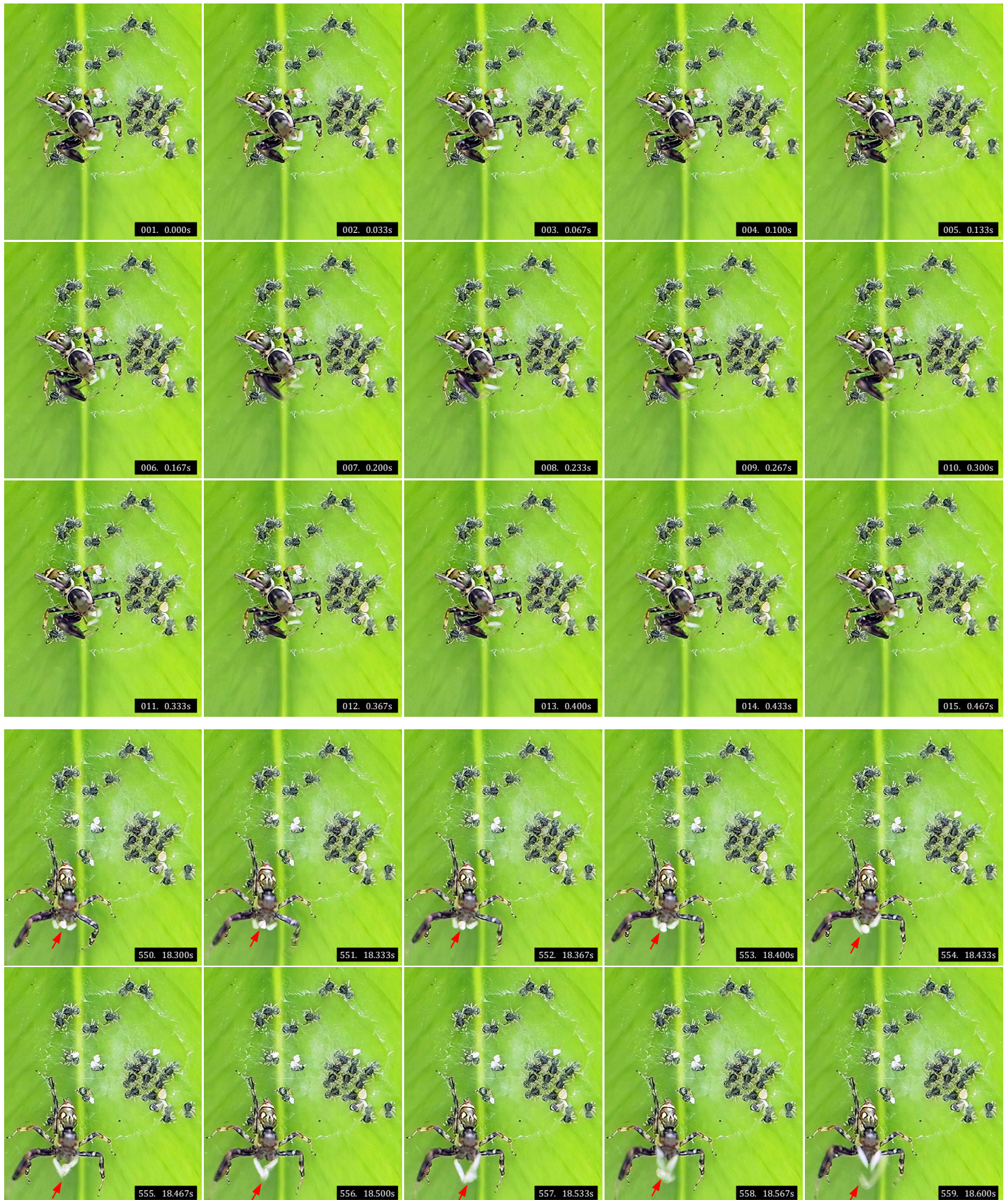
**Figure 5 (continued from previous page).** Sequence of photographs of a brooding female *Brettus cingulatus*. **23-25**, Female removing eggshell fragments from spiderlings (see Figures 6-7). **25-26**, Female guarding her brood. Note the thin cover of silk fibers that she has deposited (see Figure 8). **27-28**, Instar I spiderlings with full pigmentation. **29-30**, Instar II spiderlings.





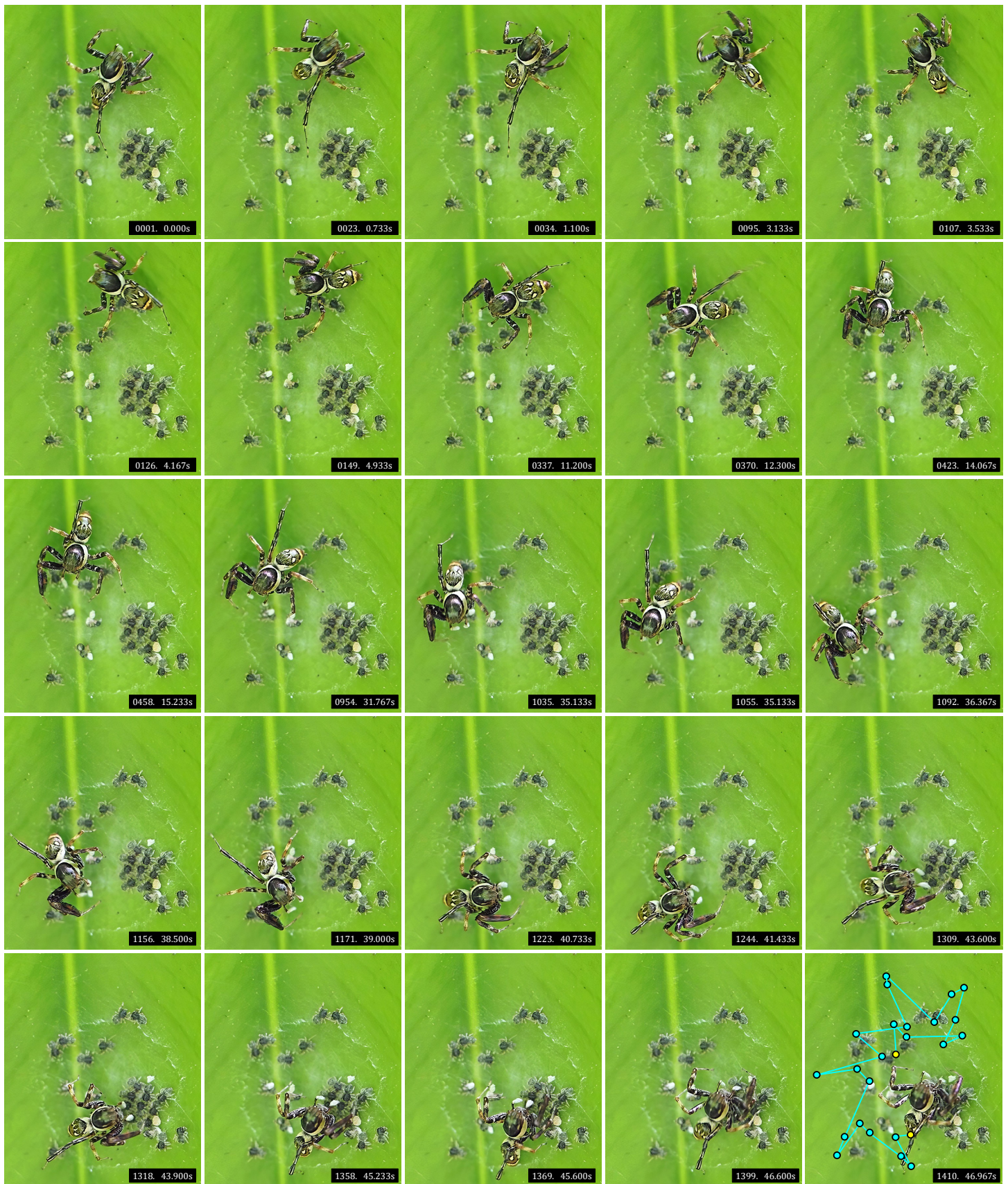
**Figure 6.** Sequence of frames from a 30 fps video of the brooding female *Brettus cingulatus* shown in Figure 5. Here, as in Figures 7-8, total elapsed time is shown after frame number at the lower right of each frame. **1-5,** The female removes remnants of the eggshell from an instar I spiderling (yellow arrow). **275-279, 682-686,** The female masticated eggshell remnants (white arrow) with her chelicerae. **772-781,** The female finished masticating the eggshell remnants, and then quickly flicked these remnants out of her nest with her feathery pedipalps. The high speed of this flick is indicated by the blurred image of the expelled material in frame 780 (streak marked by white arrow).





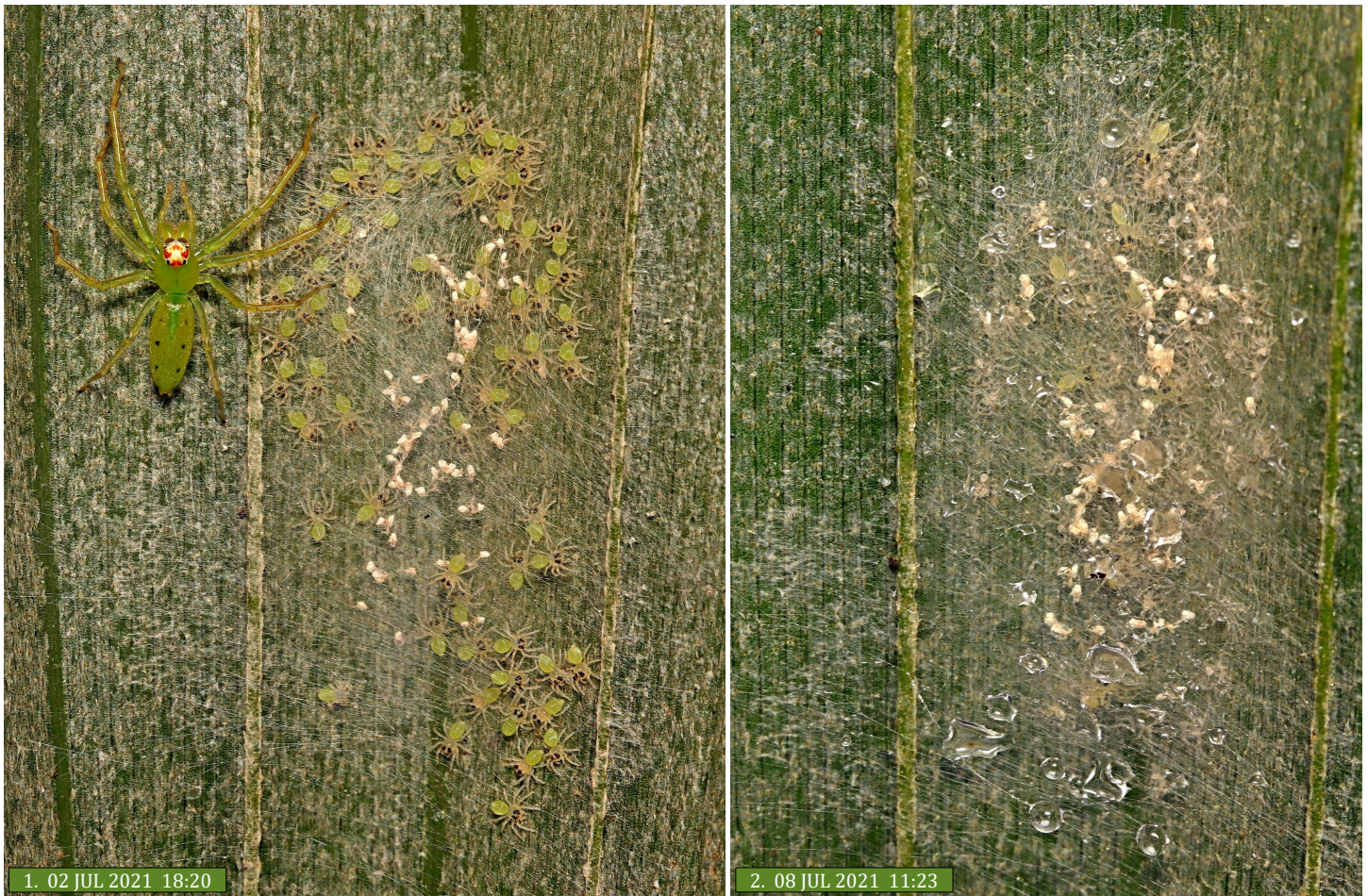
**Figure 7.** Sequence of frames from a 30 fps video of the brooding female *Brettus cingulatus* shown in Figure 5. **1-15**, Female masticating eggshell remnants with her chelicerae. **550-559**, Female flicking eggshell remnant (red arrow) away from the nest with her pedipalps.





**Figure 8.** Sequence of selected (not consecutive) frames from a 30 fps video of the brooding female *Brettus cingulatus* shown in Figure 5. These represent a series of positions at which this female attached silk lines, mostly around the periphery of the nest. This entire sequence of attachment positions is diagrammed in frame 1410 (yellow circle to yellow circle). Note that the number of young in the nest at this stage was considerably smaller than the ~43 eggs deposited by this female.





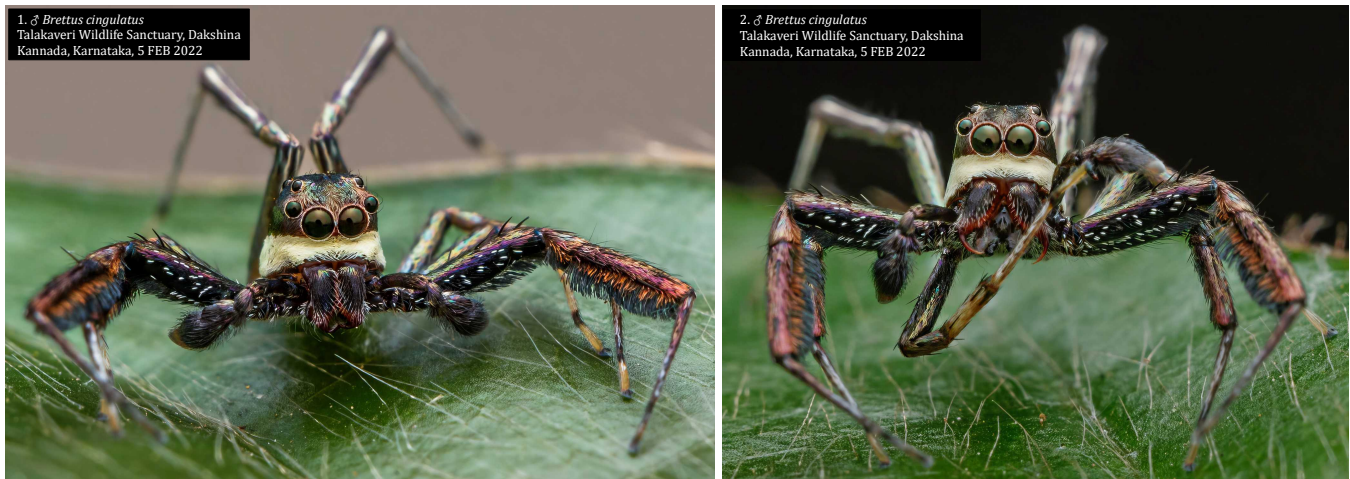
**Figure 9.** Brood of *Lyssomanes viridis* (Walckenaer 1837) on the underside of a palmetto leaf in Greenville County, South Carolina. **1**, Female (upper left) tending her brood. Note bright white eggshell remnants in the nest. By the next day (3 JUL) the female left this brood. **2**, Six days later, after most of the young had left the nest. Water droplets in the silk were the result of a heavy downpour on the previous night. Note that there is no sign that any of the silk or eggshell fragments had been removed. Photographs by David E. Hill.

After her young hatch, a female *Brettus cingulatus* will continue to guard over her nest, but may roam to nearby areas in the pursuit of prey during daylight hours.

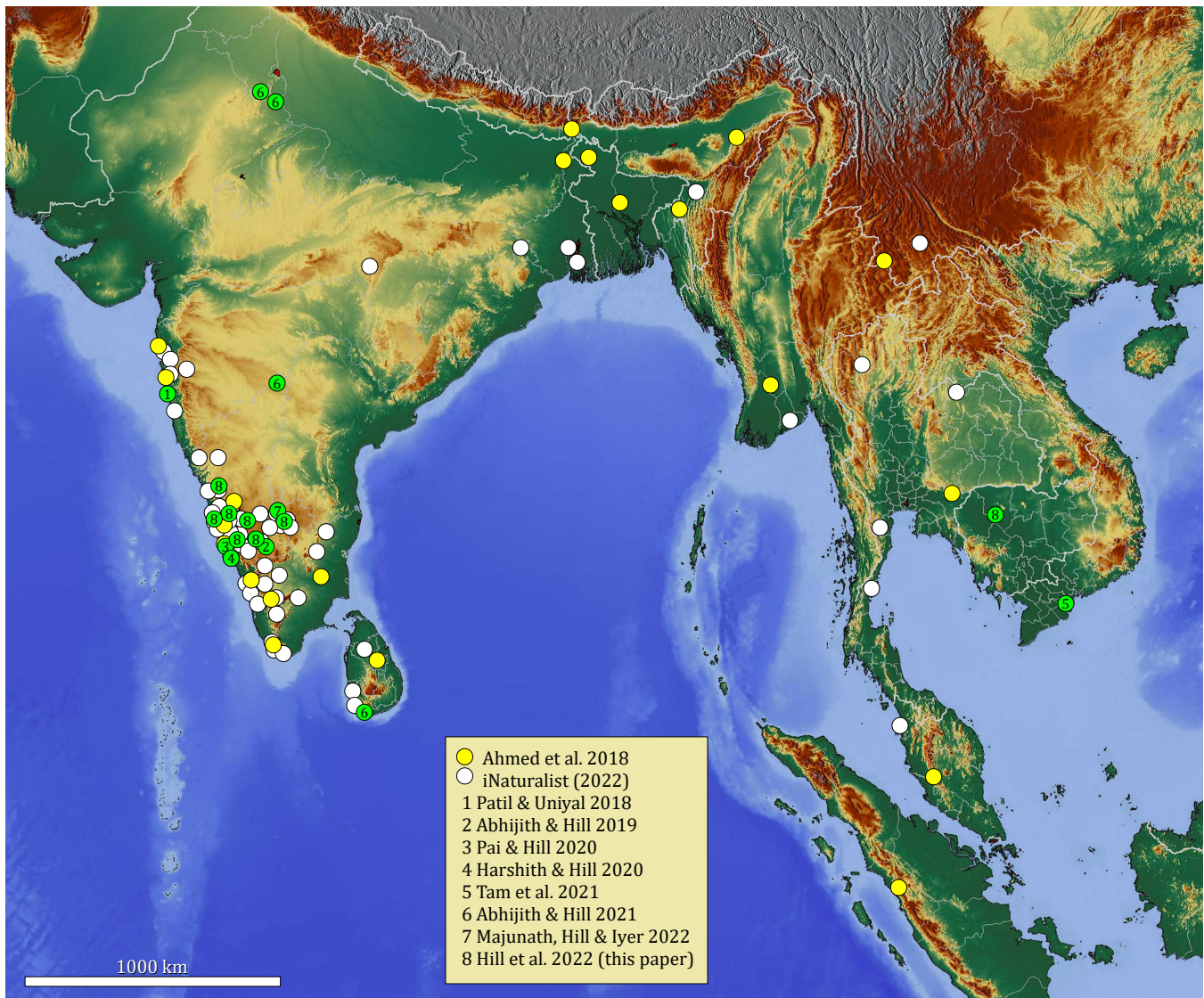
Prior to 2018 (Ahmed et al. 2018; Patil & Uniyal 2018) *B. cingulatus* was known primarily from the description of a single male collected in Burma (now Myanmar). Although the male of this species is distinctive and easy to recognize (Figure 10), the female, with a wide distribution in south and southeast Asia, was described as a separate species, *B. albolimbatus* Simon 1900. An updated map of the distribution of this species is shown in Figure 11.

*Brettus cingulatus* is a very versatile predator, and this versatility deserves much more study. Like its better-known and more cryptic cousin, *Portia* Karsch 1878, *Brettus* is quite adept at invading webs to capture web spiders (Jackson 2000; Jackson & Hallas 1986; Abhijith & Hill 2019; Kumar H M 2022). They also feed on the eggs and broods of conspecifics (Figure 12; Harshith & Hill 2020; Majunath, Hill & Iyer 2022). Remarkably, these spiders are also trophobionts on mealy bug colonies, feeding alongside the ants that tend these insects (Abhijith & Hill 2021). Here (Figure 13) we show a female *B. cingulatus* feeding on a large ant in Cambodia, to show that these spiders are also myrmecophagic.





**Figure 10.** Adult male *Brettus cingulatus*. **1**, Display with pedipalps extended to the sides. **2**, Grooming, with fangs extended and chelicerae separated to reveal the endites and rostrum to the rear. Attribution and ©: 1-2, acharya\_mr.

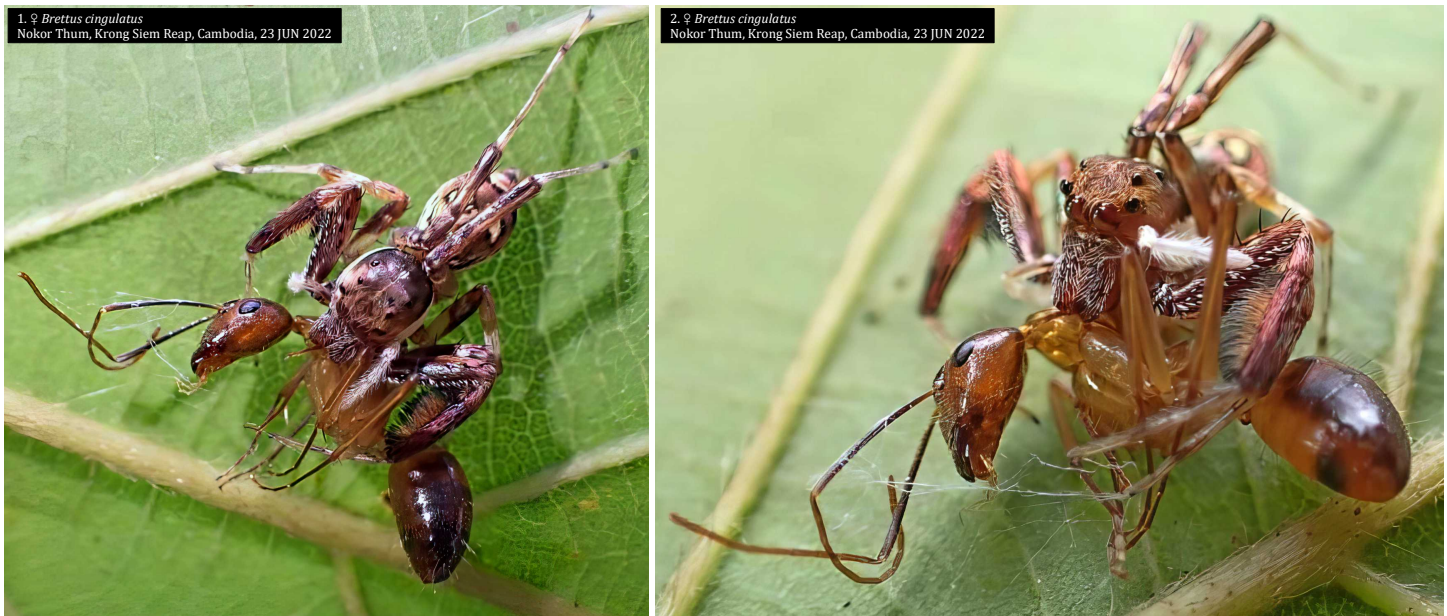


**Figure 11.** Updated distribution map for *Brettus cingulatus*, endemic to tropical south and southeast Asia. Published localities referenced by Ahmed et. al (2018) are shown in yellow. Localities corresponding to verified photographs posted in iNaturalist are shown in white. Other localities (green, 1-7) are referenced by source publication. Some circles cover more than one locality.





**Figure 12.** Immature *Brettus cingulatus* feeding on late instar I (fully pigmented) *B. cingulatus* spiderlings in an untended nest. It appears that the female left this brood without converting the egg nest to a brood nest, and the instar I spiderlings, now exposed and vulnerable outside of that nest, had no guardian. At this stage (instar I) it is likely that the spiderlings were still completely blind. Photographs by Hemanth Kumar H M.



**Figure 13.** Cambodian *Brettus cingulatus* feeding on a large ant. Attribution and ©: 1-2, mark spicer.

Mating of the brooding female *Brettus cingulatus* (Figure 5.9-19) has been reported previously (Abhijith & Hill 2019; Majunath, Hill & Iyer 2022). Here (Figure 14) we provide one more example of this behavior, this time showing a pair mating next to a brood that has already hatched and molted to the emergent (instar II) stage. The mating system of *B. cingulatus*, in which female receptivity may extend for the duration of that female's life, departs from the long-held assumption that female salticids tend to mate but once, but it is by no means unique. For example, the dendryphantine *Hentzia mitrata* (Hentz 1846) and the marpissine *Maevia inclemens* (Walckenaer 1837) are known to mate multiple times (Hill 2011, 2021). Mating after the eggs have been deposited in a nest is unusual, but this may actually be a common occurrence for tropical salticids with a less demanding seasonal regime.





**Figure 14.** Right-side mating *Brettus cingulatus* near a brood that has already molted to instar II. Photographed by Hemanth Kumar H M at Belur, Hassan district , Karnataka.

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